



Carbon^{Re}

From Reactive to Predictive: AI Fundamentals for Cement Production Engineers

PRESENTED BY: Dr Jess Rigley – ML Engineer & Dr Noah Miller – COO

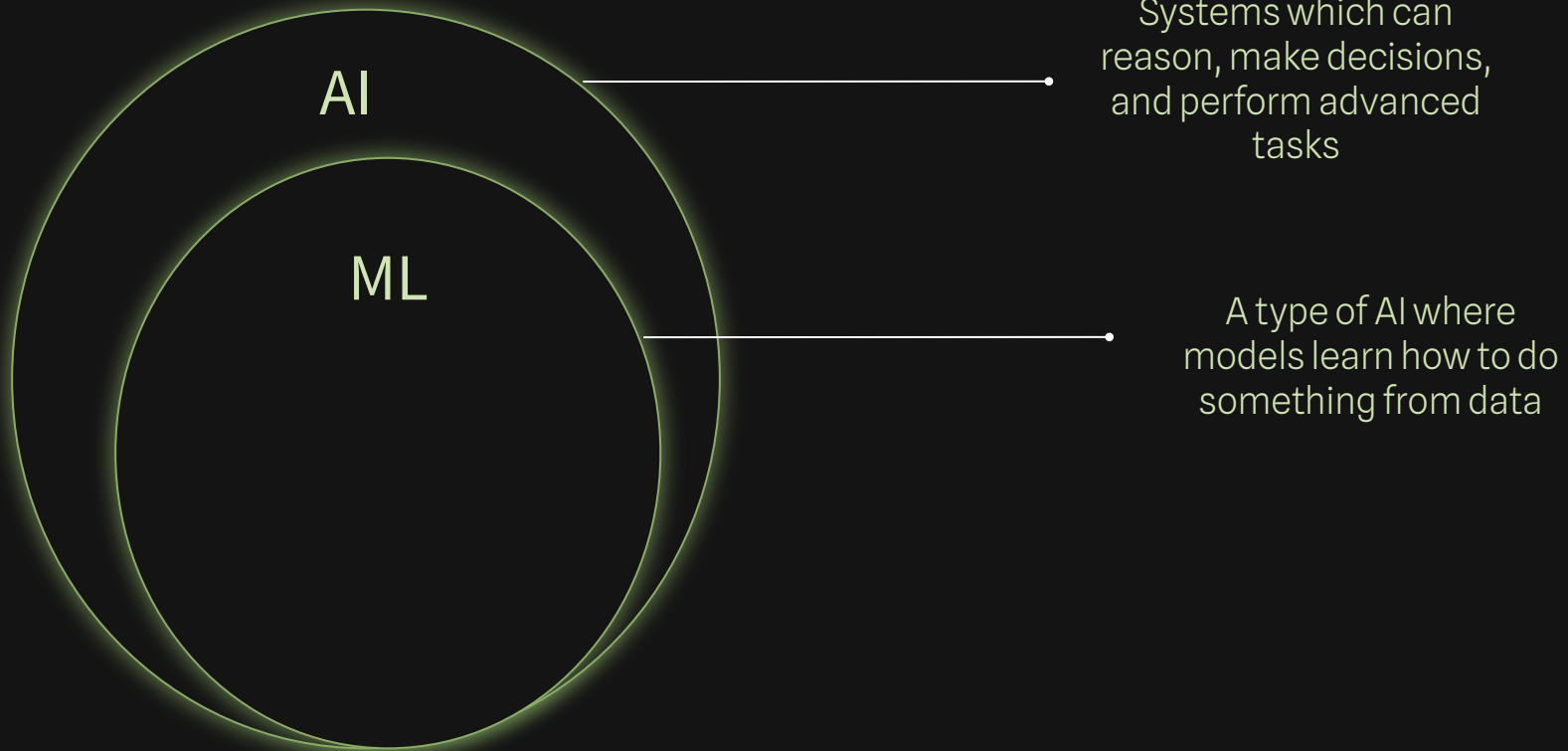
February 2026

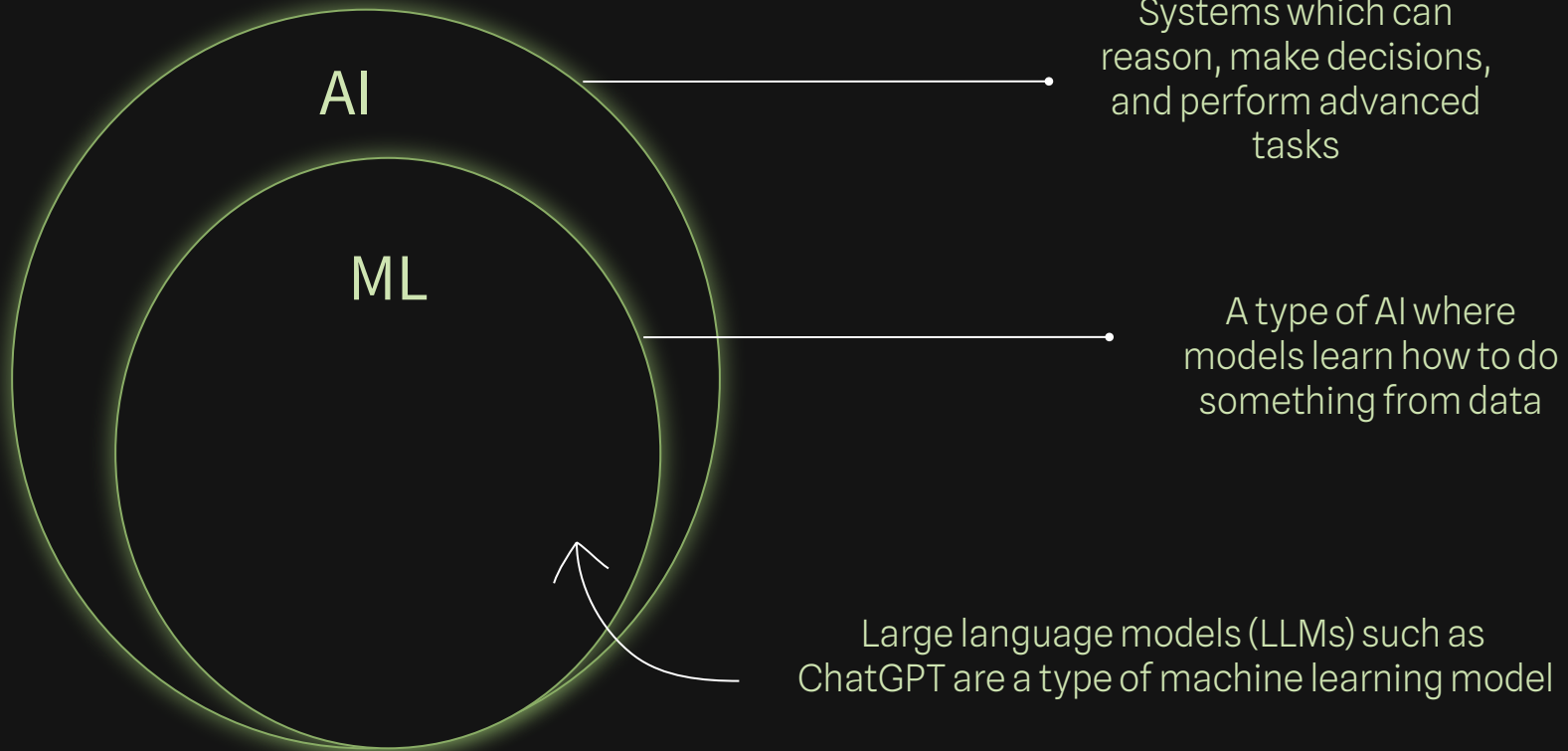
Why use AI?



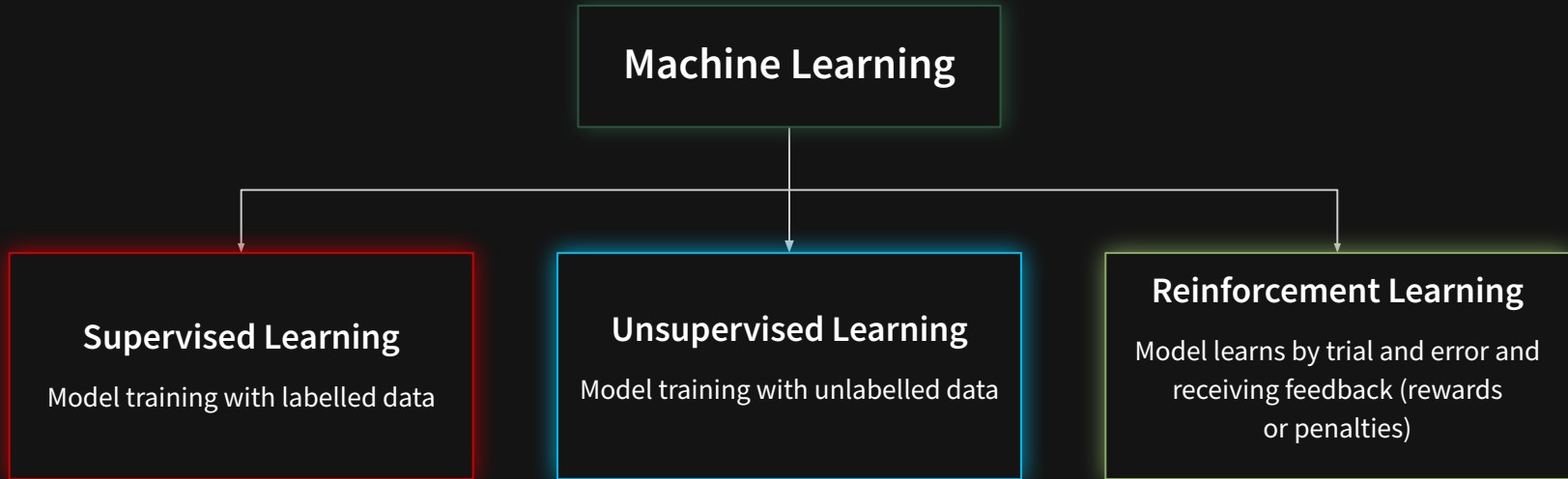
AI

Systems which can
reason, make decisions,
and perform advanced
tasks

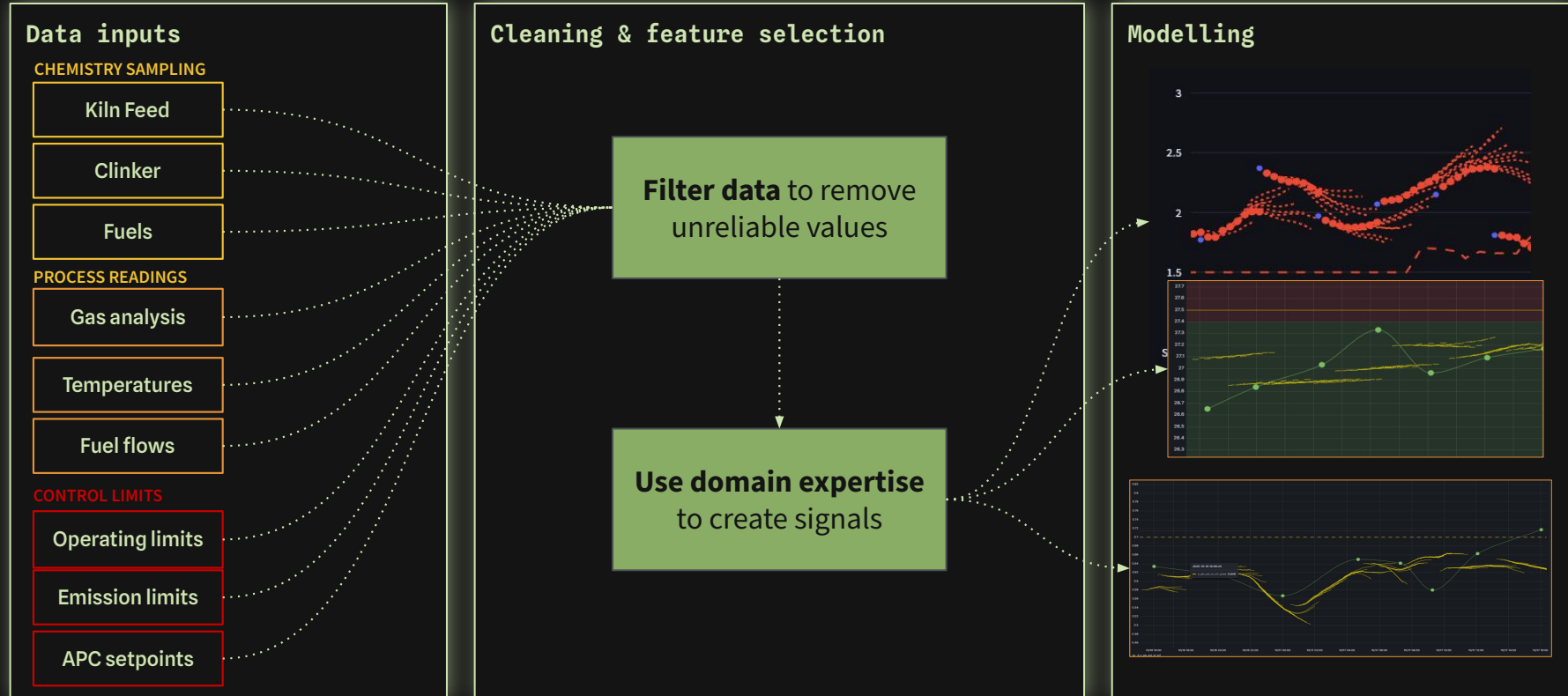




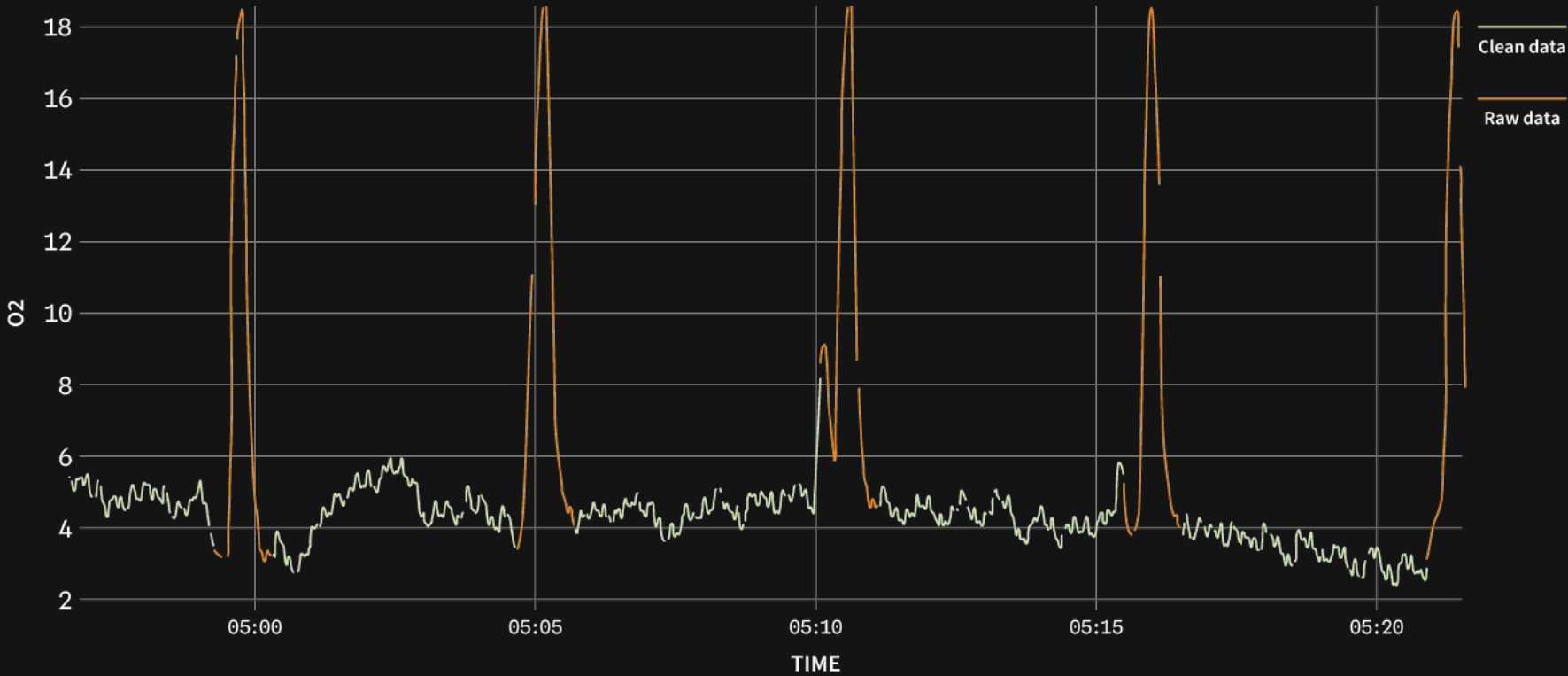
Types of machine learning



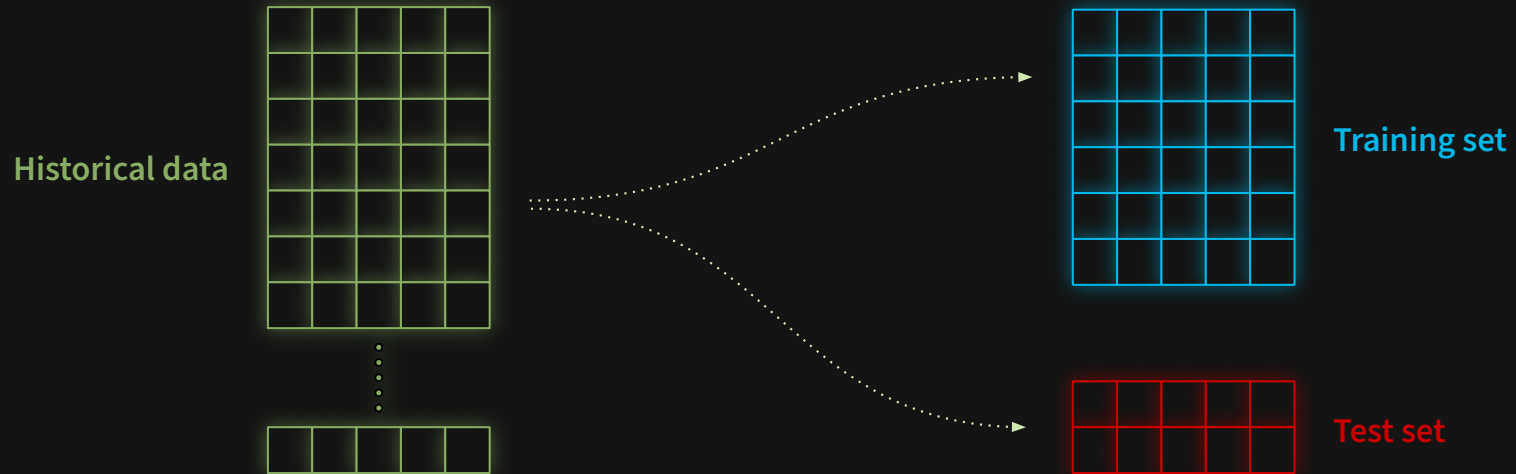
Before AI can shine, the data needs to be solid



Cleaning data: the unglamorous hero



How does a model actually learn?



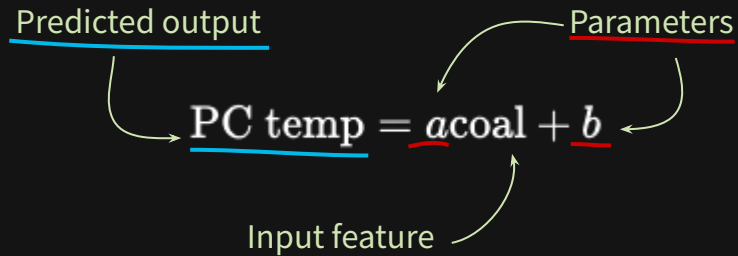
Model training in practice: linear regression

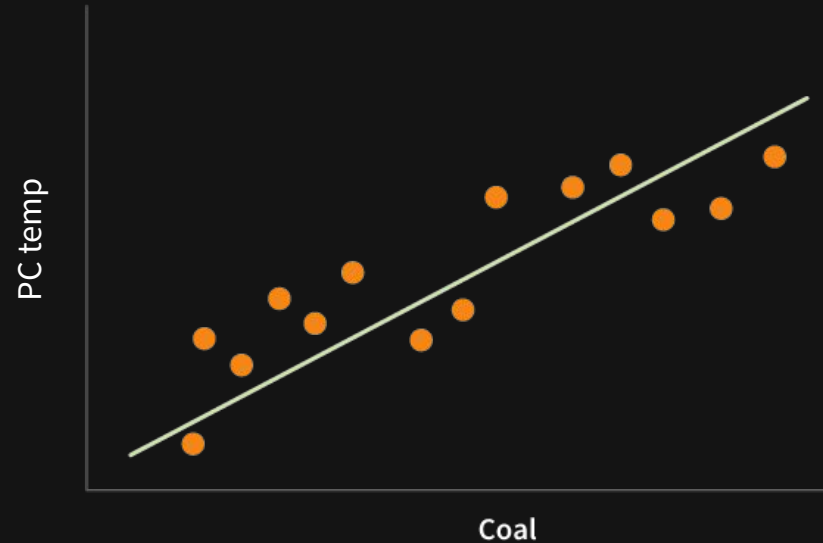
Predicted output

$$\text{PC temp} = a\text{coal} + b$$

Parameters

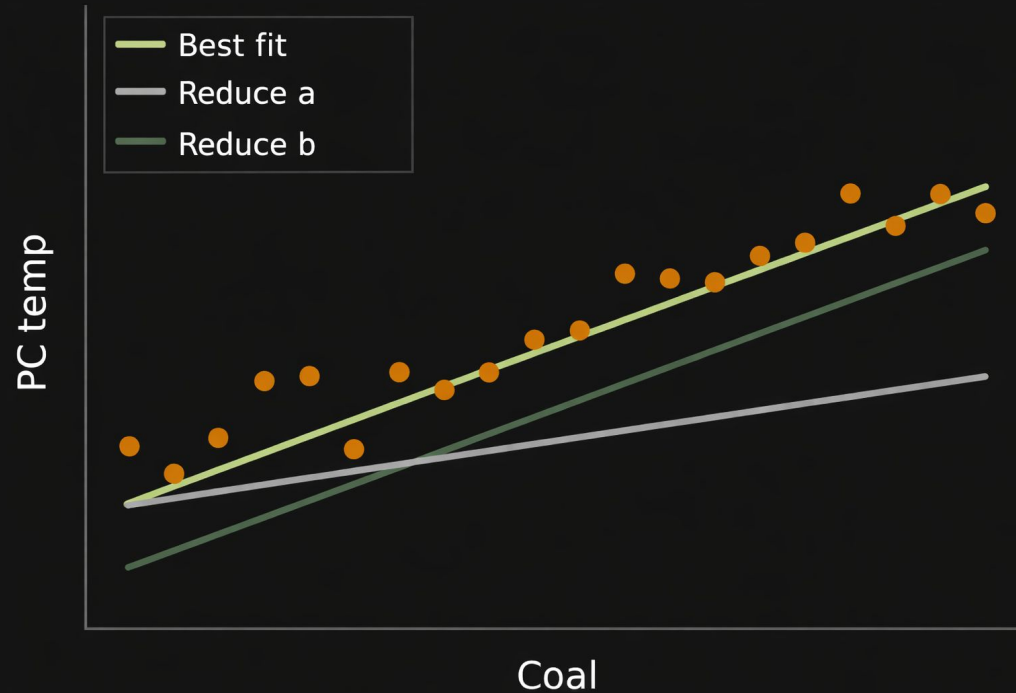
Input feature





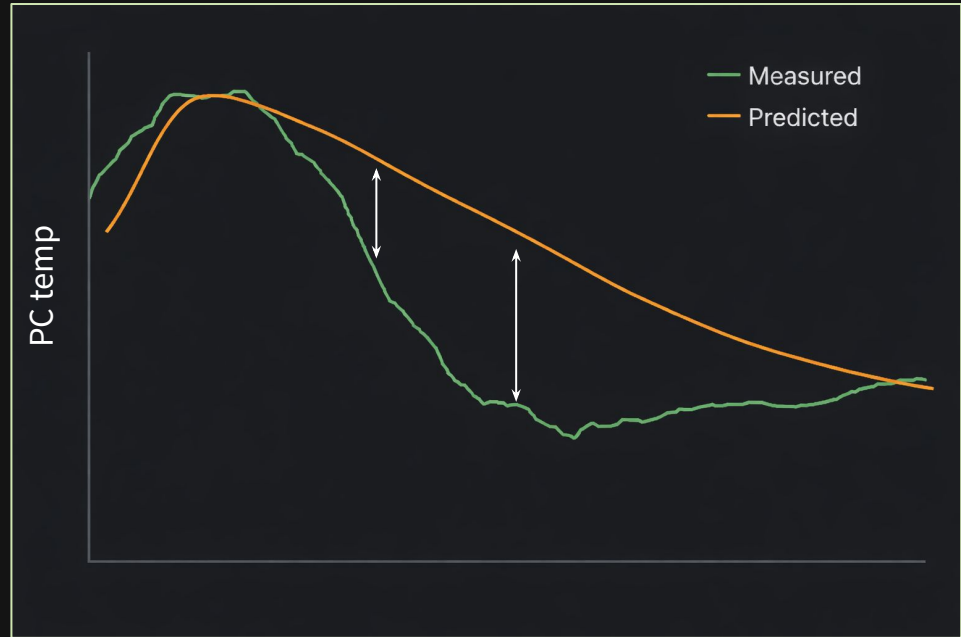
Model training in practice: linear regression

$$\text{PC temp} = a\text{coal} + b$$



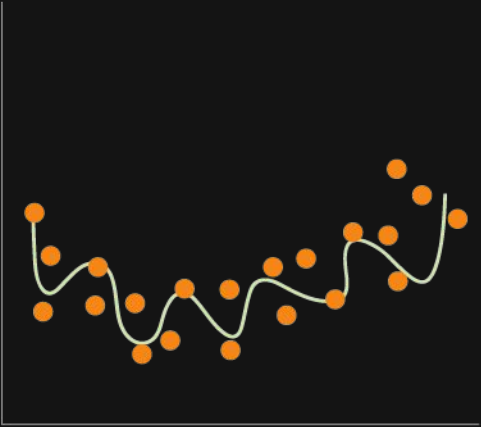
How do we evaluate a model?

- Mean absolute error
- Mean squared error
- Directionality
- Out of bounds
- Comparison to a naive baseline

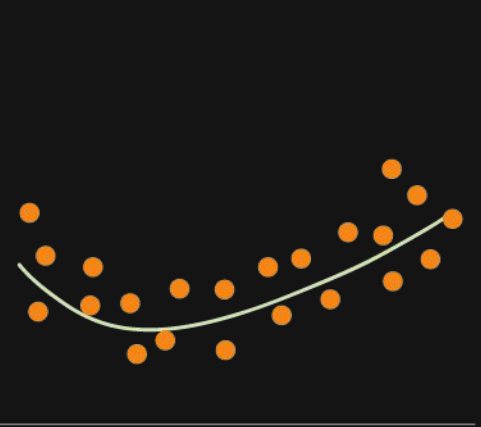


Overfitting

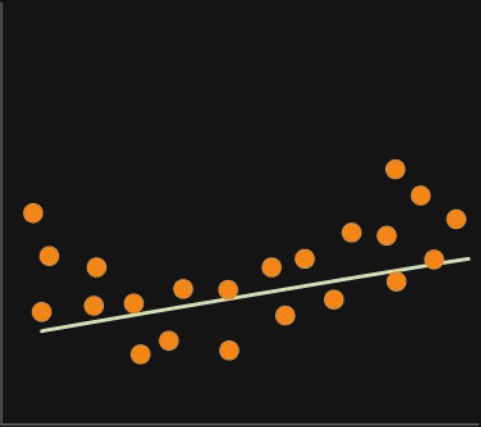
Overfit



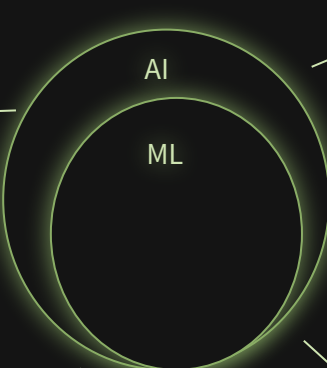
Right fit



Underfit



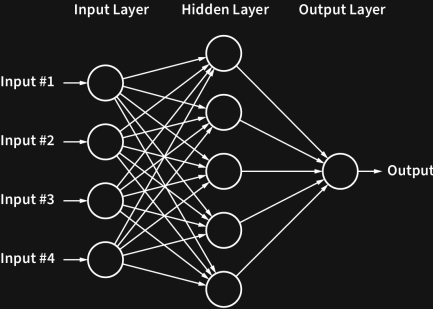
Types of models



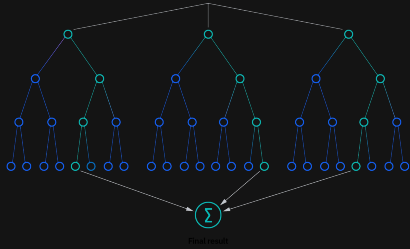
Linear regression

$$PC\ temp = a\ coal + b\ rdf + c$$

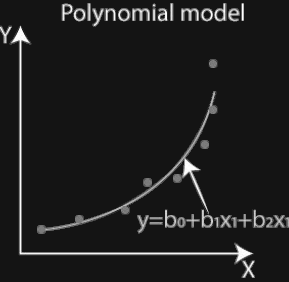
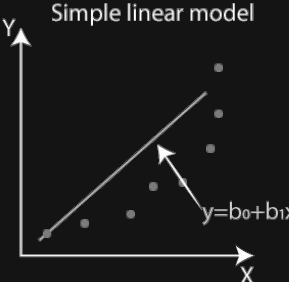
Neural network



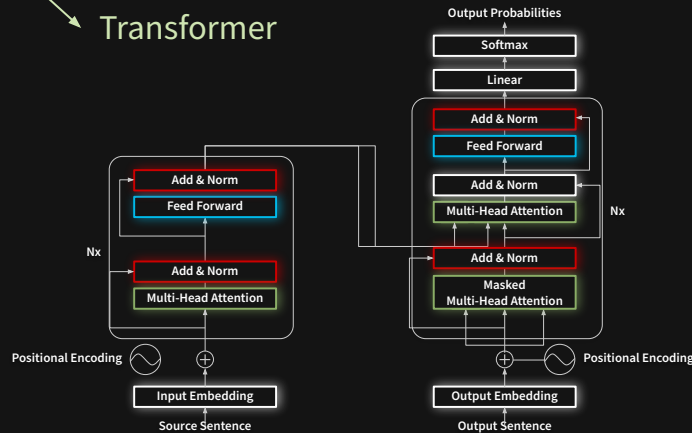
Random forest



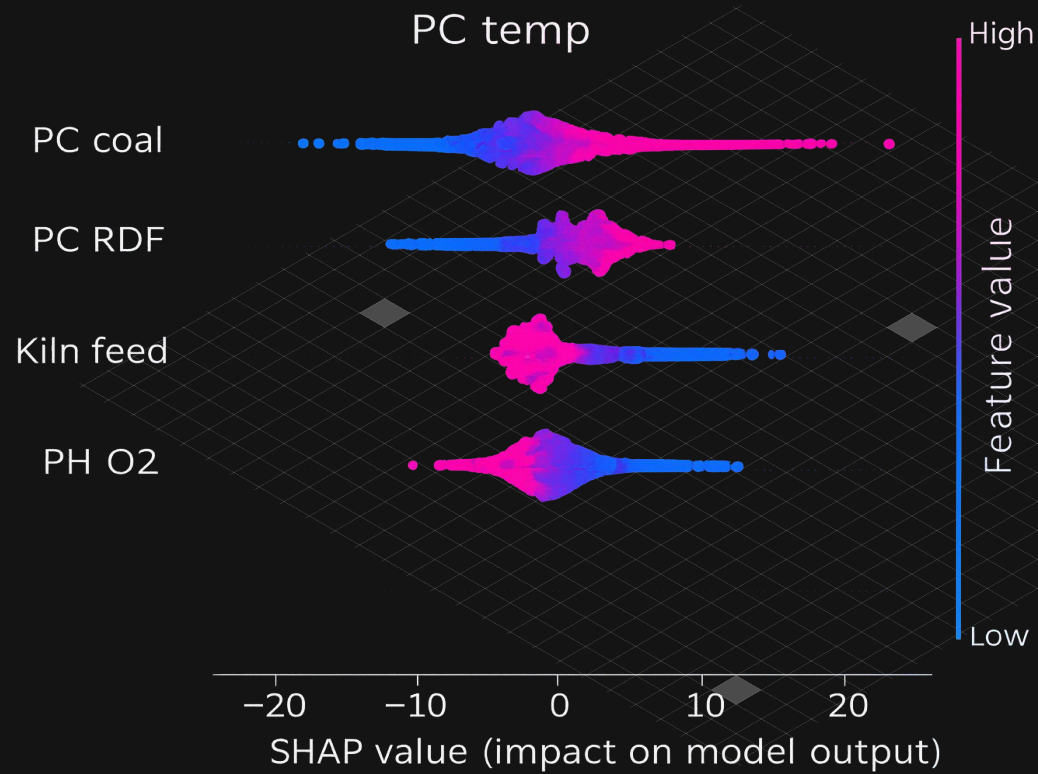
Non-linear



Transformer



Explainability



AI applied to cement: soft sensors

Predictions every 5 minutes, instead of samples every 2 hours. Meaning control actions can be taken before the process drifts.



AI applied to cement: optimisers

You choose the goal. The optimiser finds the smartest path to get there.

You set the **priority** with the AI Objective Function

Digital twin **simulates** the process evaluating all possible setpoints against the priority

Controller **recommends** the target which provides the best performance

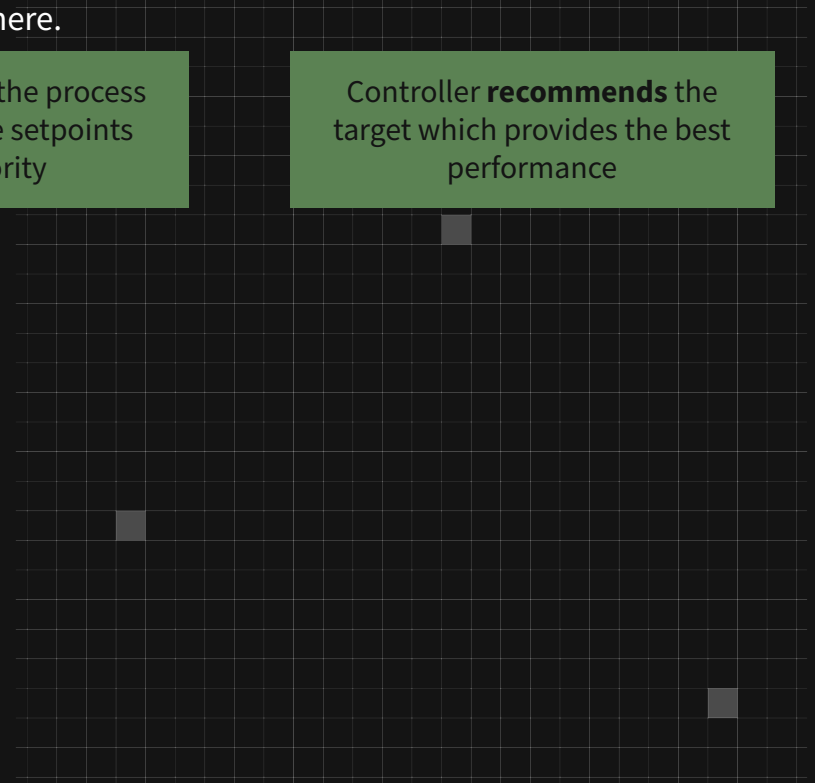
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AI applied to cement: optimisers

Every possible adjustment is tested, so the chosen setpoint is the best one for the whole system.

You set the **priority** with the AI Objective Function

OBJECTIVE FUNCTION

Fuel Cost



Alternate Fuel Use



Maximise Throughput



Clinker Quality



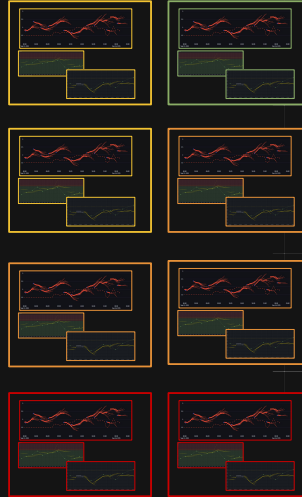
Blockage Risk



CO & NOx Limits



Digital twin **simulates** the process evaluating all possible setpoints against the priority

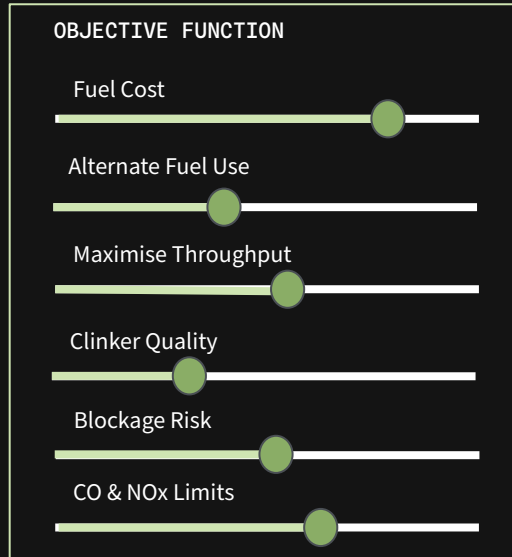


Controller **recommends** the target which provides the best performance

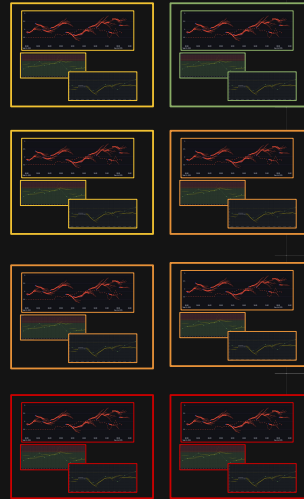
AI applied to cement: optimisers

The optimiser chooses and sets the best setpoints automatically.

You set the **priority** with the AI Objective Function



Digital twin **simulates** the process evaluating all possible setpoints against the priority



Controller **recommends** the target which provides the best performance

+0.5t | Calciner RDF

+0.13% Pre calciner oxygen set point

ML applied to cement: optimisers

By maintaining kiln stability, the plant hits its TSR goals.



Q&A

The logo features the text "Carbon^{Re}" in a light green font, centered within a dark green circle. The circle is outlined with a thin, light green border. Two white dots are positioned on the circle's circumference, one at the top and one at the right. The background is a dark gray grid with several small, dark gray squares scattered across it.

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